SCIENCE

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GOVERNMENT TIMBER TESTS.

In reply to many inquiries regarding the comprehensive timber tests inaugurated in the Forestry Division of the Department of Agriculture, the following brief statements regarding the objects and methods of the work have been prepared by B. E. Fernow, chief of the division, in the hope that thereby an interest in this investigation, a work of national importance, may be spread.

It will be admitted by all who have to handle wood in building, engineering, and manufacturing, that our knowledge regarding the properties of our various timbers is not very satisfactory, and that while attempts more or less systematic have been made to determine these properties, and knowledge gained from experience exists among those who have handled certain classes of wood for certain purposes, there does not exist much reliable published information for general use.

The reason for this deficiency may be explained from the fact that wood, being a non-homogeneous material, varies very largely in its qualities. Not only does there exist a wide range of qualities in the same species if grown under different conditions, but the quality varies in the same tree from the butt to the top, and from the heart to the bark.

To arrive, then, at any satisfactory results in an experimental determination of the properties of wood, it is necessary to derive them from test material of known origin, and, furthermore, to establish any laws which will be generally applicable in referring quality to physical appearance, structure, and origin of material, it is necessary to examine and test carefully a very large number of test specimens.

The difficulty for private enterprise to secure the test material in sufficient quantity, and with a full knowledge of its origin, in fact the magnitude of an investigation of this kind, renders it pre-eminently an undertaking for a government agency. This has also been recognized by the Prussian Government; but the United States Department of Agriculture can boast of having inaugurated such elaborate work one year earlier.

The object of this work in general will be readily perceived from the foregoing statement.

Besides more reliable data regarding the properties of our principal timbers, there is to be gained from this investigation a means of determining quality by the examination of physical appearance and structure, and of establishing an inter-relation between quality and conditions of growth.

To define the objects of the work more in detail, some of the questions which it is expected ultimately to solve may be formulated as follows: —

What are the essential working properties of our various woods and by what circumstances are they influenced? What influence does seasoning of different degree have upon quality? How do age, rapidity of growth, time of felling, and after-treatment change quality in different timbers? In what relation does structure stand to quality? How far is weight a criterion of strength? What macroscopic or microscopic aids can be devised for determining quality from physical examination? What difference is there in wood of different parts of the tree? How far do climatic and soil conditions influence quality? In what respect does tapping for turpentine affect quality of pine timber?

It is also proposed to test, as opportunity is afforded, the influence of continued service upon the strength of structural material, as, for instance, of members in bridge construction of known length of service. This series of tests will give more definite information for the use of inspectors of structures.

There are four departments necessary to carry on the work as at present organized, namely: the collecting department, the department of mechanical tests, the department of physical and microscopic examination of the test material, the department of compilation and final discussion of results.

The collection of the test material is done by experts (Dr. Charles Mohr of Mobile, Ala., for southern timbers). The trees of each species are taken from a number of localities of different soil and climatic conditions. From each site five trees of each species are cut up into logs and disks, each piece being carefully marked, so as to indicate exactly its position in the tree; four trees are chosen as representative of the average growth, the fifth or "check tree" the best developed specimen of the site.

Disks of a few young trees, as well as of limbwood, are also collected for biological study. The disk pieces are eight inches in height and contain the heart and sapwood of the tree from the north to the south side of the periphery. From fifty to seventy disk pieces and from ten to fifteen logs are thus collected for each species and site.

A full account of the conditions of soil, climate, aspect, measurements, and determinable history of tree and forest growth in general accompanies the collection from each site.

The disks are sent, wrapped in heavy paper, to the Botanical Laboratory of the University of Michigan, at Ann Arbor (Mr. F. Roth, in charge), to be studied as to their physical properties, their macroscopic and microscopic structure, rate of growth, etc. Here are determined, (*a*) the specific weight by a hygrometric method; (*b*) the amount of water and the rate of its loss by drying in relation to shrinkage; (*c*) the structural differences of the different pieces, especially as to the distribution of spring and summerwood, strong and weak cells, open vessels, medullary rays, etc.; (*d*) the rate of growth and other biological facts which may lead to the finding of relations between physical appearance, conditions of growth, and mechanical properties. The material thus studied is preserved for further examinations and tests as may appear desirable, the history of each piece being fully known and recorded.

The logs are shipped to the St. Louis Test Laboratory, in charge of Professor J. B. Johnson. They are stenciled off for sawing and each stick marked with dies, corresponding to sketch in the record, so as to be perfectly identified as to number of tree, and thereby its origin, and as to position in tree. After sawing to size, the test-pieces are stacked to await the testing. One-half of every log will be tested green, the

other half after thorough seasoning. A determination is made at the time of testing of the amount of water present in the test-piece, since this appears greatly to influence results.

From each tree there are cut two or three logs, from each log three or four sticks, two of standard size, the other one or two of larger size. Each standard stick is cut in two, and one end reserved for testing two years later after seasoning. The standard size for the sticks is 4 × 4 inches and 60 inches long for cross-breaking tests. There will, however, be made a special series of cross-breaking tests on a specially constructed beam testing machine, gauged to the Watertown testing machine, in which the full log length is utilized with a cross section of 6 by 12 up to 8 by 16 inches, in order to establish the comparative value of beam-tests to those on the small test-pieces. It is expected that, on the average, 50 tests will be made on each tree, besides 4 or 5 beam-tests, or 250 tests for each species and site.

All due caution will be exercised to perfect and insure the accuracy of methods; and, besides the records, which are made directly in ink into permanent books, avoiding mistakes in copying, a series of photographs, exhibiting the character of the rupture, will assist in the ultimate study of the material, which is also preserved.

Such work as this, if done as indicated, and well done, will never need to be done over again. The results will become the standard, the world over. The strength and value of a given species or even stick will then no longer be a matter of opinion, but a question of established fact, and we will learn not only to apply our timbers to the use to which they are best adapted, but also what conditions produce required qualities, thus directing the consumer of present supplies and the forest grower of the future.

The American Association for the Advancement of Science, in its Section of Mechanics and Engineering, has created an Advisory Board to assist in securing improved methods, and the co-operation of other authorities will be welcomed to make this a truly national work.

So far the work has been confined to southern pines and oaks (which, thanks to the courtesy of the Louisville and Nashville Railroad Company, could be obtained free of transportation charges); the scant appropriations available, and other unfavorable conditions, making such limitation necessary.

The work will be extended and its progress pushed in proportion to appropriations made by Congress, which depend upon the interest which the work may arouse among those to be benefited by it.

FIRE-RESISTING MATERIALS.

TESTS were held on Oct. 15, in two buildings erected in a vacant lot on Park Street, Boston, Mass., for the purpose of demonstrating the efficiency of slow-burning construction, and also of various materials designed to retard free combustion. In addition to asbestos paper and ordinary lath and plaster, the materials manufactured by the following companies were used, being contributed by their representatives,—King's Windsor Cement Dry Mortar Company, Clinton Wire Cloth Company, New Jersey Wire Cloth Company, Magneso-Calcite Fire-Proof Company (who manufacture a fire-proof paper), Boston Fire-Proofing Company (who manufacture porous terra-cotta lumber), New York Eastern Plaster Board Company (manufacturers of cellular blocks of plaster of Paris mixed with fibrous vegetable matter), Stark, Edson, & Co. (manufacturers of albamural, which is a fire-proofing material in general appearance similar to kalsomine).

The buildings were constructed of two-inch tongued and grooved spruce plank placed upright and held by a grooved plate at the top. They were covered by flat plank roofs tinned on the upper side.

The larger building was 12 x 16, divided into four cells, with a fire door in each partition and one at the eastern end. The other building measured 12 x 12, being divided into three cells, and situated three feet from the larger building. Scuttles about two feet square were placed in the roof over each cell, but they were opened when the fire was started. The entrance at the front of each cell was provided with doors made of two-inch plank tinned on the edges and on the side toward the fire.

For the purpose of obtaining approximate temperatures in the buildings at the test, four links furnished by Mr. Morris Martin of the United States Electric Fire Alarm Company were hung on steel wire in the upper part of each cell, and the melting points of these links were stated to be as follows: lead, 626°; antimony, 842°; aluminum alloy, 1,292°; brass, 1,850°. Each of the cells was lined with fire-retarding material.

After the buildings had been thoroughly examined by those present, the fuel was placed in each cell, consisting of kiln-dried hickory wood piled to a depth of nearly four feet, and also piled to the depth of over five feet in the space between the two buildings. This wood was thoroughly wet with kerosene oil, and the fires were lighted at 12.21 P.M., simultaneously in each cell. Although the fires burned very fiercely, the buildings resisted the flames admirably, and it was considered that up to 1.30 P.M., or an hour and ten minutes after the fires were started, any burning of the buildings could have been extinguished with a pail of water.

The heat of the fire was too severe to allow near enough approach to make very careful or accurate observations of the interior until after the fire was extinguished by the fire department, who applied a hose stream upon the fires, beginning at 1.52 P.M. After the fires were extinguished, careful observations were taken of the conditions of each cell as it was at the time, and later further examinations of the floors were made after the ashes had been removed.

There were shutters placed upon the ends of the buildings. The wooden shutter covered with tin was somewhat injured and the wood badly charred. The shutter covered with one-eighth of an inch magneso-calcite, before the tin was applied, was in excellent condition. The fire doors in the partitions in the larger building all yielded during the fire. The immediate cause of their failure appeared to be the use of screws in attaching the hinges, and in this respect as well as others they all differed from what is known as the standard tin-covered fire doors, which require that all attachments to the doors shall be made by bolts and not by screws.

The doors in the partition were held in position, after the hinges gave way, by the mass of fuel piled on either side. The doors covered with asbestos paper or with magneso-calcite, before applying the tin, were somewhat distended by the gas generated by the heated wood, which could not escape readily, as was the case in the doors not covered except by the tin, where the gas could escape at the seams.

The doors at the front of the cells were tinned only on the edges and the side toward the fire, and were able to resist the heat of the fire for only about an hour, the cause of the failure in each case being the conduction of the heat along

the lines of the screws at the hinges. These doors would undoubtedly have fallen earlier had they not been open a great portion of the time during the fire.

The heat of the fires apparently exceeded that of an ordinary burning building.

Among the principal facts established at this test, the committee conducting the experiment, consisting of C. J. H. Woodbury, C. M. Goddard, and D. L. Lord, wish to call attention to the great resistance to fire afforded by the solid plank construction, the walls being in themselves adequate to prevent the spread of a fire until it has reached a quite large extent; and such construction should in many instances be used in place of ordinary joisted partition. While it is not claimed that such solid plank partitions are equal to a brick division in resistance to fire, yet there are many places where the difficulty of supporting a brick wall would render such a division out of the question, and yet a plank partition could be placed as readily as one supported on joist.

The porous terra-cotta lumber and the Eastern plaster board both presented a high resistance to heat, and were unaffected by exposure to the fires.

The secure bond of the wire lath, especially when re-enforced by band iron, proved the value of this material in securely holding plasters when exposed to fire.

The magneso-calcite proved its value for re-enforcing tinned fire doors and shutters, resisting the fire, and yielding only when the material to which it was attached fell.

The King's Windsor cement dry mortar resisted the fire in a most efficient manner when the support of the back remained, and, moreover, did not crumble as a result of heat or of streams of water played upon it when hot, as was the case with the ordinary lime mortar.

NOTES AND NEWS.

THE difficulty of keeping Irish potatoes in edible condition after March 1 is well known to Southern housekeepers, farmers, and merchants. Professor Schribaux of the National College of Agriculture of France has recently devised a very simple, cheap, and successful method by which he has been able to preserve potatoes in edible condition for over a year and a half. This process has been adopted by the French government for preserving potatoes for the army. The French Minister of Agriculture publishes the details of the process in the official *Bulletin du Ministére de l'Agriculture* for March, 1891. The following is a translation of the essential part of the scheme. The method of preservation consists in plunging the tubers, before storing them away, for ten hours into a two per cent solution of commercial sulphuric acid in water, two parts of acid to 100 parts of water. The acid penetrates the eyes to the depth of about one-fortieth of an inch, which serves to destroy their sprouting power; it does not have any appreciable effect upon the skin of the potatoes. After remaining in the liquid ten hours the tubers must be thoroughly dried before storing away. The same liquid may be used any number of times with equally good results. A barrel or tank of any kind will do for the treatment. The acid is so dilute it does not affect the wood. Chemical analysis shows that potatoes treated by this process are as nutritious and healthful after eighteen months as when freshly dug; but they are of course worthless for planting. Attention is called to this method by Gerald McCarthy, N. C. Experiment Station, Raleigh.

— Dr. B. A. Gould, president of the American Metrological Society, writes from Germany that at the quinquennial session of the Geographical International Congress held in Berne Aug. 10–17 there were about 280 delegates and representatives from all countries. At this congress was passed the following resolution on Aug. 14: "The Geographical Congress entreats Englishmen of science to desist in future from the use of their ancient units of weight and measure in scientific and technical publications, and to employ those of the metric system only." This resolution was passed with immense enthusiasm; the applause and cheering lasting for nearly five minutes, and the vote was unanimous. In connection with this the American Metrological Society has prepared a petition asking Congress to pass the following act: "That on and after July 1, 1893, the metric system of weights and measures authorized by the act of Congress approved July 28, 1866, shall be used exclusively in the customs service in the United States." This petition they desire to circulate widely among those desiring to sign it, and they ask each signer to mail it to his representative in Congress. The American Metrological Society has prepared a simple chart of the metric system which, for educational purposes, it will mail to any one asking for it for 10 cents in stamps. Address Secretary of American Metrological Society, No. 41 East 49th Street, New York City. Copies of the petition can be had at the same address.

— Dr. Wiesendenger describes a new method of producing anæsthesia by the application of cold, the characteristic feature of which is that it is not the cold-producing agent which touches the desired part, but a metallic tube or chamber which is cooled by carbonic acid. The cold may, according to the requirements of the case, be regulated from the temperature of cold water to one sufficiently low to cauterize. The first symptom of this artificial cold is anæmia of the cellular tissue, producing a slight sensation of burning, which is followed by anæsthesia, which lasts from one to two minutes and then disappears without any ill effects. As the instrument may be manufactured of almost any shape, it is evident that this new method may be used for a variety of purposes. The simple turning of a tap will regulate the stream of carbonic acid to any degree of temperature down to four degrees Fahrenheit. No moisture is produced. In using this cold for the purpose of cauterizing the surgeon has the advantage of producing anæsthesia at the same time. When applying it to any of the internal cavities, such as the mouth, it is necessary to have the parts carefully dried, as the tissues would otherwise adhere to the instrument. Dr. Kummel applied the method, according to *The Lancet*, in the case of a boy in the Maria Hospital at Hamburg with such complete success that the boy looked on without moving a muscle while a deep incision of twelve centimetres in length was made in his thigh.

— The hospice of the great St. Bernard (7,609 feet above the sea-level) is said to have been founded A.D. 962 by St. Bernard of Menthon, while, according to some authorities, it rose a century earlier, under Charlemagne. Neither saint nor emperor is likely to make good his claim, as the archives of the hospice have been completely destroyed in two successive conflagrations. But, like other Christian institutions, it had undoubtedly a pagan predecessor. The Romans on the self-same spot built a temple to the Pennine Jove, and that, in turn, occupied the site of a still earlier shrine of prehistoric antiquity. The truth is, the Alpine passes were in common use from the remotest ages — the Christian world treading the same route which had been trodden by the Romans, who also availed themselves of the track made by the aborigines. At its highest point the tutelary deity had his place of worship, and this was served by the local priesthood, who rendered assistance to the distressed or ailing traveller and received votive tributes in return for its good offices. The existence of a temple of Jupiter on the spot, with its staff of priests, is well known; and the relics that have turned up near it attest its uses to have been similar to those of the present hospice. A discovery of importance, says *The Lancet*, has just been made in its vicinity — a bronze statue in excellent preservation of Jupiter himself. Its artistic value is very great; its height, forty centimetres. At the same time other treasure-trove was brought to the surface, including a number of medals and a statuette of a lion measuring sixteen centimetres, also of fine workmanship. These are now the property of the monks, and will attract to the hospice a public more able to keep them in funds than the proper recipients of their kindness. Sad to relate, the revenues of the monastery, heavily drawn upon by the travellers (from 16,000 to 20,000 annually) who throw themselves on its bounty, are diminishing, the contributions left by these comfortably accommodated guests being

miserably below what, in the majority of cases, they can afford. The heroism of the monks should be remembered by the well-to-do holiday visitor. They begin their career at the age of eighteen or nineteen. After fifteen years' service the severe climate has made old men of them. For eight or nine months out of the twelve they see none but the poorest wayfarers, when the cold is intense, the snow lying deep, the danger from storms incessant and fearful. Their sole companions are the dogs, whose keen scent has guided them to the snow wreath under which the buried traveller has so often been rescued and brought to life — dogs like that noble fellow "Barry," who saved forty men in his time, and who now, carefully stuffed, adorns the museum at Bern.

— The Brooklyn Institute announces courses of lectures on Geology and Archæology, by Professor Franklin W. Hooper. The separate courses will be devoted to physiography, the earth's structure, the earth's history, glaciers of the age of ice, local geology, and archæology. Each of the lectures will be illustrated by sixty or more lantern photographs and by collections of geological or archæological specimens. The courses are subject to alteration to meet special requirements. The Institute will conduct these courses of lectures on the so-called "University Extension" plan, under the title of "Institute Extension Lectures." Each lecture will be preceded by a conference on the subject of the previous lecture. A syllabus of each course of lectures, together with directions for reading and study, will be provided. Those who desire may present themselves for examination at the close of a course by giving ten days' notice. Certificates will be issued by the Institute to those who pass a satisfactory examination. Arrangements for courses may be made with the Institute. The lectures may be given in the rooms occupied by the Institute, or at any convenient point in Brooklyn and the immediate vicinity. The Institute Extension Lectures are independent of the other work at the Institute, and special course tickets are necessary for admission to them.

— The report of Arthur Winslow, State geologist of Missouri, shows that, during the month of October, inspections of iron ore deposits have been made in Randolph, Monroe, Benton, Henry, Hickory, Franklin, Reynolds, Crawford, and Dent Counties. Inspections of lead and zinc deposits have been made in Pettis, Benton, Hickory, Camden, Miller, Cole, Osage, Franklin, and Reynolds Counties. Inspections of coal beds have been made in Cooper, Saline, and Lafayette Counties, and surveys have been made for the purpose of constructing a model of an important coal deposit in the first named county. Detailed mapping has been prosecuted in Henry, Benton, and St. Francois Counties, and over 230 square miles have been covered. For outlining the areas of the crystalline rocks examinations have been made of an area covering about 300 square miles in Reynolds and Iron Counties, and the areas of the geological formations in portions of six townships in Greene and Polk Counties have similarly been mapped. Examinations of important clays of the State have been continued and additional experimental tests on sixteen samples of such are now completed. In the office much has been done on the preliminary report on the coal deposits of the State, which will be placed in the printer's hands this month. Work on the preparation of the reports on the mineral waters and on the paleontology of the State has also progressed well. Further, much draughting has been done of illustrations to accompany reports of detailed maps and sections. Engraving of these maps has been started and can now be continued uninterruptedly with the supply of maps which have been prepared during the past months. Bulletin No. 5 has been distributed.

— No sooner is one antiseptic chemical rejected by some disappointed disciple of antisepticism, says the *Medical Press*, than he is greeted by a new chemical possessing all the virtues and free from all the vices of its predecessor. The list commenced with the peerless carbolic acid and its many preparations, all of which made way for the ill-smelling iodoform or the poisonous corrosive sublimate; these in turn were pushed aside for newer and more popular remedies, until "ariostol" claimed notice; still, however, the search goes on, and of course the demand begets a supply. Dr. Berlioz now presents to the Parisian Academy of Medicine a new chemical which already has proven itself worthy, if we accept the statements of its advocates, of general recognition as the best of antiseptics. He names it "microcidine," a name which it is hardly entitled to, seeing that its germicide powers are inferior to those of corrosive sublimate. According to Professor Polaillon, the new drug is not a definite chemical compound, but rather a mixture of B naphthol and hydroxylate of sodium. This new product is soluble in three times its weight of cold water, the solution being of a brown color, which disappears on dilution. The chief advantages claimed for this, the latest of antiseptics, is its slight cost, and that it is non-poisonous.

— A new use has been found for waste glass. Any fragments of broken glass of various colors are mixed together, after having been broken to a suitable size; they are then placed in moulds lined with silica, talc, or some other resisting material, and fired. A coherent mass is produced which can be dressed and cut into blocks, which are, of course, irregularly colored. Such blocks may be used as artificial marble. The blocks are usually rough on one side, owing perhaps to incomplete fusion; this gives a surface which is admirably adapted for causing them, especially if they are slab-like in form, to adhere to walls with the addition of a little mortar. Fine decorative effects can thus be produced. Designs in relief can be obtained by pressure while the block or slab is still plastic. If a suitable mould be prepared with movable partitions, then pieces of glass can be arranged in such a way that, upon firing, a very effective "stained-glass" window is produced, the necessity of using "leading," as in the ordinary way, being thus obviated.

— The other day, Mr. Flinders Petrie delivered at the Owens College, Manchester, a most interesting address on exploration in Egypt which is reported in *Nature*. It had been thought, he said, that the immense mounds of rubbish indicating the sites of towns had been made on purpose, but they resulted from the natural decay of the mud-brick buildings. These heaps of ruined walls and earth and potsherds rose even to eighty feet high in some places; but other ancient sites were much less imposing, and might even not attract notice on the open desert. The higher the mound the longer the place had been inhabited; and if the surface was of a late period, the earlier parts, which were most needed, were under such a depth of rubbish as to be practically inaccessible. Much could be known at first sight; and prospecting had now become as scientific a matter in antiquities as in geology. Knowing, by a glance at the sherds on the top, what was the latest period of occupation of the site, and knowing the usual rate of accumulation of a mud-brick town — about five feet in a century — we could guess how far back the bottom of the mound must be dated. Other remains had different indications. If in the midst of a great mound there was a wide flat crater, that was probably the temple site, surrounded by houses which had accumulated high on all sides of it. Speaking of the results of exploration, Mr. Petrie said that we now realized what the course of the arts had been in Egypt. In the earliest days yet known to us — about 4000 B.C. — we found great skill in executing accurate and massive stonework, such skill as had hardly ever been exceeded. We found elaborate tools used, jewelled saws and tubular drills. We saw the pictorial arts as fully developed as they were for thousands of years later. But what led up to this we were still feeling for.

— Dr. H. von Wlislocki, as we learn from *Nature*, has published a capital paper on the handicrafts of Hungarian gypsies, whom he has had many opportunities of observing. If we may judge from the illustrations, they have a considerable aptitude for design. In the summer they make bottles out of pumpkins, which they decorate with various drawings. On each bottle the space is divided into four zones, crosses being cut into the uppermost zone, serpents into the second one, circles into the third, and zigzag lines into the fourth. The crosses mean "May you be happy!"; the serpents, "May you have no enemies!"; the circles, "May you always have money!"; the zigzag lines, "May you be healthy!" Brandy is kept in the bottles; and when a guest is received, the first gypsy who drinks says, "May you be happy!"; the second, "May you have no enemies!"— and so on. Pretty walking-sticks are also among the things made by the Hungarian

gypsies. On the top of one of those sketched in the article two female heads are admirably carved. These represent Ana, the Queen of the Keschalyis, or forest fairies, who dwell among the mountains, where they sit — three being always together — on rocks, spreading out their long hair over the valleys, thus giving rise to mists. Queen Ana lives in a black palace, and sometimes wanders over the world in the form of a frog. Frogs, toads, and serpents are her favorite animals. When she meets any one in her natural form, she exclaims "Ana!", which means "Bring!" Should the person understand the cry and bring a frog, a toad, or a serpent, he is richly rewarded. If he fails to do so, he is either killed with a piece of a rock, or struck by some terrible malady.

— The belief is quite general among strawberry growers that imperfect flowered varieties are less liable to injury by frost than perfect, or staminate flowered sorts. Two heavy frosts occurred on May 5 and 17, 1891, which did much injury, as all varieties were then in bloom. The large number of varieties on trial at the Ohio Agricultural Station made it possible to test the accuracy of the belief above stated. The Enhance and Parker Earl, both varieties having perfect flowers, escaped with but little more injury than the imperfect flowered sorts, but aside from these exceptions, the varieties of this class suffered far more injury than those having imperfect flowers. These varieties are later in blooming than most others, and possibly they are uncommonly hardy, but it is safe to make the generalization that perfect flowered sorts are less hardy when in bloom than those having imperfect flowers.

— Some interesting facts about the tastes and manners of London board-school children were brought out at a meeting of the workers of the Children's Happy Evenings Association, held at the house of Mrs. Moberley Bell, who will in future act as honorary secretary of the Association. According to *The Educational Times*, the room where children gather to listen to fairy tales, play quiet games, and do needlework is more popular than the room given over to romping and noisy games. Painting is the favorite occupation, and with the paint boxes provided by the Association the children delight in coloring the illustrated advertisements from daily and weekly papers—one lady worker remarking that fashion advertisements were first favorites. The experience of the workers seemed to be that it was quite possible for the boys and girls to dance and play together, and that the effect was beneficial to both, provided the staff of helpers was sufficiently large.

— In the *Revue Agricole*, published in Mauritius, M. A. Daruty de Grandpré gives an account of his attempts to raise sugar-cane from seeds. The seeds, according to *Nature*, were sent from Barbados by the Governor in March, 1890. M. de Grandpré planted them with the greatest care, and after five days was fortunate enough to obtain five minute seedlings out of the hundred seeds used. The young plants he raised did not all prove equally vigorous, and he was able to save only one, which, at the time when his report was written, had formed a fine clump of twenty shoots with long ribbon leaves. "I believe," he says, "that we may with reason cherish the most sanguine hopes from from the propagation of sugar-cane from seeds — more especially if we try an intelligent system of cross-fertilization of the varieties we possess — rather than by planting cuttings, which maintain without appreciable alteration the respective characteristics of the parent plants. Thus we shall be able to supplement the weak points in our best varieties of sugar-cane by crossing them with others which are remarkable for the qualities it is intended to infuse into them, and we shall moreover obtain, by a process of selection, a cane rich in saccharine matter, which will enable us to compete successfully against the highly improved sugar-beet."

— The Association of Colleges in New England, impressed with the real unity of interest and the need of mutual sympathy and help throughout the different grades of public education, invites the attention of the public to the following changes in the programme of New England grammar schools which it recommends gradual adoption: (1) The introduction of elementary natural history into the earlier years of the programme as a substantial subject, to be taught by demonstrations and practical exercises rather than from books. (2) The introduction of elementary physics into the later years of the programme as a substantial subject, to be taught by the experimental or laboratory method, and to include exact weighing and measuring by the pupils themselves. (3) The introduction of elementary algebra at an age not later than twelve years. (4) The introduction of elementary plane geometry at an age not later than thirteen years. (5) The offering of opportunity to study French, or German, or Latin, or any two of these languages, from and after the age of ten years. In order to make room in the programme for these new subjects the Association recommends that the time allotted to arithmetic, geography, and English grammar be reduced to whatever extent may be necessary. The Association makes these recommendations in the interest of the public school system as a whole; but most of them are offered more particularly in the interest of those children whose education is not to be continued beyond the grammar school. At the thirty-fifth annual meeting of the Association, held at Brown University, Nov. 5–6, it was voted that these suggested changes be transmitted to the various faculties for their consideration and for action by the Association next year.

— A case which occurred in Sussex illustrates well the manifold sources from which arsenical poisoning may be derived. A man named Wesley, we learn from the *British Medical Journal*, died with symptoms of gastro-enteritis, while five other people in the family were taken seriously ill. It transpired that they had all partaken of some home-made gooseberry wine, and that this had been stored in a cask previously used for the reception of a certain weed-killer largely composed of arsenic, and there could be but little doubt that the poisoning was due to the arsenic. A case very similar to this occurred some years ago, when a man lost his life by drinking beer out of a pot which had been cleansed with a patent cleansing fluid containing arsenic, and there is also the well-known wholesale poisoning at an industrial school, when over 300 children were poisoned by some water being added to their morning milk which had been drawn from a tank recently cleansed of fur by a solution of arsenite of soda. Happily on that occasion no fatal result occurred; but the result was not so fortunate in the Bradford peppermint-lozenges case, when out of 200 sufferers seventeen died; here arsenic had been used to adulterate the lozenges in mistake for sulphate of lime. Another case of accidental poisoning will doubtless be fresh in the recollection of our readers, when the poison was absorbed through the skin; we refer to the two infants who lost their lives through the use of a violet powder into the composition of which arsenic had entered. The lesson to be learned from the recent and other cases is that cleansing liquids are very dangerous things.

— The Scientific Alliance of New York, recently organized, includes the New York Academy of Sciences, the Torrey Botanical Club, the New York Microscopical Society, the Linnæan Society of New York, the New York Mineralogical Club, and the New York Mathematical Society. The secretary of the council is Dr. N. L. Britton of Columbia College, to whose efforts the new system is principally credited. Instead of announcements separately issued, the members of the different societies receive in a single bulletin a comprehensive statement of the proposed meetings of each for the month, and as persons frequently are members of several of the societies the convenience of the direct comparison which is provided in dates and subjects is at once appreciated. A folding card bulletin, as easy of reference as a calendar, gives one space to the notices of each society, and one of the spaces contains a general chronological index. An additional fold is given in any issue for special announcements when required. The highly approved plan of unity of measures thus in operation is similar in principle to that of Burlington House, London, and if succeeding in the manner expected from present favorable circumstances, the New York Scientific Alliance will be established at some future day in a building of its own, containing many united collections in one great exhibition.

SCIENCE:

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

PROFESSOR WILLIAM FERREL.

WILLIAM FERREL was born in Pennsylvania, 1817. In 1856, at the age of thirty-nine, he began a series of studies in meteorology, which, in their more finished form, in later years gave a new aspect to this science, and placed him at the time of his death, Sept. 18, 1891, at the front of American meteorologists. His work was always quietly done, never with any attempt at the conversion of the great public, or almost with indifference to the attitude of the scientific public regarding his beliefs; but with the patient conviction that he was working in the right direction and that his theories would in time receive general acceptance. Towards the close of his life, this happy end was reached, as far as the better informed meteorologists of the world were concerned, and in Europe as well as in this country, Ferrel was regarded as the leader in the methods of mathematical meteorology; not that others who followed in his paths did not exceed him in completeness of demonstrations, but that the methods which he introduced into the science were essentially the same as those by which his successors carried it further. A comprehensive narrative of his life is given in the *American Meteorological Journal* for February, 1888, by Alexander McAdie of the Weather Bureau, and a list of his publications in the same journal for October last; I shall therefore here only touch on what seems to me highly characteristic of his work, and of the revolution that it produced in scientific meteorology.

Unscientific meteorology, such as was current before Ferrel's work reformed it, cannot yet be said to be excluded from popular acceptance. We still find writers who take Maury as their authority, following his antiquated views, quite unaware that they are thirty years behind the times. I do not wish to detract in the least from the deserved reputation gained by Maury for his persevering study of the winds and currents of the ocean; for the great incentive that he gave to ship-masters to become observers and bring home a careful record of their observations. The tabulation of the facts thus gathered formed the basis of wind charts for the several oceans, first produced in this country, and closely followed by the hydrographers of many foreign nations. It is on this collection of facts that Maury's reputation rests secure; and not on his theories, for they were essentially wrong and are now practically laid aside. Unfortunately for his success in this department of science, Maury seems not to have been well equipped with knowledge of physics and mathematics, and in his ignorance of these subjects he was led into serious errors as to the motions of the winds. Those errors have been considered by various writers, but by none earlier or more effectively than by Ferrel, who, in 1856, published an essay in the Nashville *Journal of Medicine*, an essay prompted by the insufficiency of Maury's theories. It is not necessary to enter here into an exposition of Ferrel's theory; those who wish to study it may find its fullest statement in his latest work, a "Popular Treatise on the Winds," published in 1889. Some statement of these theories may be found in *Science*, ix., 1887, 539; and xv., 1890, 142. But it may be briefly said that the difference between Maury's theory and Ferrel's is as the difference between darkness and light.

Maury thought the return current from the poles was in this hemisphere an east-north-east wind: Ferrel showed that it is a west-north-west wind. Maury was not alone in thinking that the polar return current flowed in our latitudes from the north-east. Dove, the leading German meteorologist of the middle decades of this century, had the same idea, and, I think, at an earlier date than Maury. According to Dove, the alternation of north-east and south-west winds that we feel with the passage of our storms centres is simply the contest of the polar and equatorial currents, of which first one and then the other reach the surface of the earth. This view, embodying the idea of the north-east-south-west course of the polar return current, may be said to have held an accepted place in meteorology at the time when Ferrel prepared his first essay on the subject. But for those who have followed Ferrel's work, the north-east return current has no existence. His reasons for giving this return current a north-west source are simple and ample; and for those who do not share this view, there is a large fact in nature which cannot be explained; namely, the low pressure about the North Pole; a similar arrangement prevailing in the Southern Hemisphere, where the return current comes from the south west.

This seems to be a small matter. It is a slight change to make in words, to say that the return polar current comes from the north-west, not from the north-east: and truly, if this were all that could be said, it would not be a great affair. But if the reader will examine the question carefully, and study the development of our knowledge of the winds, he will soon be convinced that the introduction of Ferrel's idea as to the course of the polar return current and the explanation of the low pressure that is bound up with it, marks the introduction of rational physical principles into this department of meteorology. This change came at a time when the physical study of meteorology was a rare thing. Look, for example, at Schmid's "Meteorologie" of 1860, a voluminous treatise, well representing the condition of the science then; compare with it Spring's "Lehrbuch" of 1885, in which the science is presented in the manner introduced by Ferrel. The difference is that between statistical, inductive methods, and fully expanded logical methods that utilize all means of inquiry. The science has become a new thing by this change; would that meteorologists had as greatly changed and were not still so content to read instruments and count up totals and means.

If we were to search Ferrel's writings for the most important principle introduced by him into the study of meteorology, it would be found in the deflective force arising from the earth's rotation, by which all bodies moving on the earth's surface tend to turn to the right in this hemisphere, but to the left in the southern. It is curious in reading over the general run of meteorological essays to notice how inadequately the action of this force is considered. In the first place, it is too commonly said to act only on meridional motions; that is, to make a poleward motion run ahead of its initial meridian, or an equatorward motion fall behind; but to have no effect on a motion to the east or west. This is incorrect, for, as Ferrel shows, the deflective force is independent of the azimuth of motion, and varies only with the velocity of motion and the sine of the latitude. In this he was preceded by others, who discussed the mathematical aspects of the question; but if we except the overlooked article of Tracy, no one before Ferrel correctly introduced the action of the deflective force into meteorology. It is not simply that a wind tends to turn aside from the gradient, as may be seem by the most elementary inpection of our weather maps; but that, in thus turning aside, it reacts on the distribution of pressure by which its motion is caused, and produces a very significant re-arrangement of pressures in some cases. This was first demonstrated by Ferrel; and if the student wishes to appreciate the conditions under which the winds move, he should follow this subject out to its end. The most conspicuous effect of the re-arrangement of pressures in this manner is the reduction of the polar high pressures, such as would exist if determined by low temperature alone, into low pressures: for, on account of the earth's rotation, the whole system of terrestrial winds in temperate and frigid latitudes runs in a great whirl around the poles from west to east; and the centrifugal force thus developed in excess of that characterizing the rotation of the earth itself, suffices to withhold so much air from the polar regions that the anticipated high pressure due to low temperature cannot occur there: the air thus withheld from the polar regions forms a broad belt of high pressure around the tropics. The importance of this even in elementary teaching must be apparent; for when a teacher tells his class that the general winds flow because the difference of temperature between the equator and the poles establishes a convectional circulation, the class has a right to ask why the region of low temperature is not the region of high pressure, as it should be in a convectional circulation. No sufficient answer to this significant question is to be found in any text-book in our language, except Ferrel's "Popular Treatise." Not only so; some of the most eminent meteorologists give no particular attention to this aspect of the question. For example, in the recent "Report on the Meteorology of the Challenger Expedition," the most beautifully illustrated of any meteorological work ever published, Buchan passes over the matter without alluding to Ferrel's explanation of it, and without giving any adequate explanation of it himself. In Germany there is a much better appreciation of the nature of the case, as far as it is represented by the investigations of mathematicians and the discussions in recent text-books. The contrast between the attitude of the conservative British and the progressive German schools may indeed be taken as indicating the difference between the older and the more modern status of meteorology; the division between the two being on the lines marked out by Ferrel. Certainly, when we find that the general distribution of atmospheric pressure, the general direction of the greater part of the atmospheric circulation and the general velocity of its motion all depend on the deflective forces arising from the earth's rotation, it is not unfair to claim for them and for the investigator who first properly introduced them a large share of credit in the recent advances of meteorology. It is the same with cyclones; those of the torrid regions, where the deflective force is small, present illustrations of distributions of pressure and circulation of wind dependent chiefly on differences of temperature and local centrifugal force; but in temperate latitudes, where the sine of the latitude is of a considerable value, the low pressure of the central part of the cyclonic storms is in great part the product of outward deflective force that accompanies the motion of the winds Finally, even in the small vorticular whirls of tornadoes, the deflective force has its effect; not directly, as in the case with cyclones proper, but indirectly: the tornado whirls around because it is developed in a whirling cyclone, and the cyclone turns because it is developed on a rotating earth. Indeed, in following through Ferrel's admirable theory of tornadoes, the only theory of tornadoes worthy of a name, it is made clear that if the deflective force of the earth's rotation were not, indirectly at least, communicated to the tornado, its violence would be greatly reduced, perhaps to the degree of rendering it nearly harmless.

The introduction of a general principle into a science, whereby a variety of apparently independent facts are found to be bound together by a comparatively simple relation, is in itself a great contribution to knowledge. The grand views of the correlations that connect all the winds of the world that are gained through Ferrel's essays repay the effort needed to study them out to the point of clear understanding; not that the essays are obscure or unnecessarily complex, but that their reading involves a rather clear knowledge of physics and mechanics, not to speak of mathematics, and a careful following of close reasoning from premises to conclusions.

No just appreciation of Ferrel's simple life and broad scientific work can be given in a brief article. His work in meteorology is much more varied than may be inferred from the emphasis here given to a single one of the leading principles that he followed. The others will be found by the faithful students of his books. His studies in other subjects than meteorology are of sufficient importance to deserve a separate notice. He was far enough advanced in astronomy, while employed in our Nautical Almanac office, to give new understanding to one of the puzzles of the sky; an unaccounted acceleration of the moon's motion was explained by him as a result of a retardation of the earth's rotation, caused by the action of the tides. The interaction of the lunar and terrestrial tides was also perceived, and when in the Coast Survey office in Washington, the calculation of tide-tables at our Atlantic ports was a subject of advanced study. A tide-predicting machine was then devised, by which the labor of thirty or forty men is now saved. Later in the Signal Office, Ferrel prepared his report on "Recent Advances in Meteorology," and gave lectures to the lieutenants on duty there, the substance of these lectures being now published in the "Popular Treatise on the Winds," referred to above.

Ferrel's simple manner of living kept him apart from the world about him; he had warm friends, but they were comparatively few. These few unite in feeling that it was a privilege to know such a man; modest, unassuming, even humble in his ways; yet with an insight into the truths of nature that goes only with rare genius. He was one of the small number of men in the world who not only advance the limits of knowledge, but who turn the search for it into

new courses. It is safe to say that while he must already be regarded as the most eminent meteorologist of our country, the true measure of his eminence will be better recognized when those who follow the science that he enlarged come to appreciate more fully what he did for it.

W. M. D.

PROFESSOR JOSEPH LEIDY: HIS LABORS IN THE FIELD OF VERTEBRATE ANATOMY.[1]

WE hear it said that at no time have the conditions for intellectual attainment been so favorable as in the days of Athenian supremacy. This may be true for communities, but not for individuals. Surely the atmosphere of Philadelphia from 1823 to 1891 favored greatness in science, else there is no connection between the man and his environment. Is it not a truth that it only needs the man to come forward to claim favoring conditions, to insist upon them as his own, to have another like Joseph Leidy to be bred among us? A man to whom questions of birth and of patronage were as nothing; one with a common school education and without the subsequent advantages of training under distinguished masters; one to whom all things required for his well-being appeared to come like the beneficent forces of nature until we are apt to lose sight of the will and of the steadfast purpose that directed them. He was never

"limited and vexed
By a divided and delusive aim,"

but, fixed and invariable in his methods, he completed a unique career.

He dedicated himself early to anatomy, and it is about this science as a central stem that all his labors cluster.

Signs of immaturity are evident in the early labors of most men. But this was not the case with Leidy. His first paper, entitled, "Notes on the White Pond in New Jersey" (Proc. Phil. Acad. Nat. Sci., 1847) exhibited the same clear observation and lucidity of statement which characterize his subsequent writings. The earliest of his anatomical papers ("On the Fossil Horse of America," Proc. Phil. Acad. Nat. Sci., 1847, 262) was in no respect inferior to any of his numerous records in the literature of paleontology of North America. The word growth used in respect to him is inappropriate. In the best sense of the word he never grew. Rather, like Bichat, he simply unfolded the native resources which lay innate within him.

For his graduating thesis in medicine he treated of the eye in vertebrate animals. This essay has not been published. In his twenty-second year, namely, July 29, 1845, he was elected a member of the academy, and from this date to that of his election to the chair of anatomy in the University of Pennsylvania, eight years later, his communications were in the main devoted to the structure and properties of the vertebrates. In this interval his industry was great, for he was actively engaged at the same time in teaching, and in assisting Professor W. E. Hoone in his anatomical work, and Professor George B. Wood in dissecting and mounting pathological specimens. He described the retention of the intermaxillary suture in the skull of a New Hollander (Proc. Phil. Acad. Nat. Sci., 1847), also one on the same bodies in the boa constrictor resembling the Pacinian corpuscles (Proc. Phil. Acad. Nat. Sci., 1848, 27). He wrote a paper on the existence of the intermaxillary bone in the embryo of the human subject of the tenth week (Proc. Phil. Acad. Nat. Sci., 1848, 45).

[1] Read at a special meeting of the Philadelphia Academy of Natural Sciences, May 5, 1891, by Harrison Allen, M.D.

Remarkable instances of preservation of organized animal matter were reported by him in 1847 (Proc. Phil. Acad. Nat. Sci., 313) on the films and cartilaginous structures in the extinct genera *Basilosaurus* and *Megalonyx*, the former a reptile of the eocene and the latter a mammal of the pliocene age. The vertebræ of *Basilosaurus* retained tissue which when burnt gave out animal odor. Fibrous membranes taken from one of the bones of *Megalonyx* exhibited many of the characteristics of recent membrane; in the articular cartilages the corpuscles were well preserved and distinct. It was held that under favoring conditions the cartilaginous and fibrous tissue might be preserved for an indefinite period.

In 1848 (Proc. Phil. Acad. Sci., 116) Dr. Leidy read remarks on the development of the Purkinjean corpuscles in bone; on the intimate structure of articular cartilage, and on the arrangement of aveolar sheath of muscular fascicute and its relation to tendon.

Cartilage was found to possess numbers of fine, transparent filaments, nearly uniform in thickness, having an average measurement of $\frac{1}{25000}$ of an inch. Hunter had claimed this fibrilation, but without the aid of the microscope it cannot be demonstrated. This cannot be said to be a prior claim. Professor George A. Piersol has kindly informed me that Dr. Leidy was the first to make the announcement of a fact now accepted. Kolliker was inclined to regard the appearance as pathological. The fibrillar nature of the matrix of all dense connective tissue, including cartilage and bone, is now universally recognized. The comments upon the arrangement of the aveolar sheath of muscular fascicute were to the effect that "the filaments of fibrous tissue cross each other diagonally around the muscular fascicute, forming a double spiral extensive sheath. When the filaments reach the rounded extremities of the fascicute they become straight and in this manner conjoin with the tendinous filaments originating at the extremities of the muscular fibres. The importance of this arrangement can be readily understood, from the diagonally crossing of the aveolar filaments, comparatively inelastic in themselves, the sheath is rendered elastic, thus permitting the muscle fibres freely to move without their action being interfered with."

Dr. Leidy was in the habit of introducing these comments in his lectures when speaking of the function of fibres depending upon their position to each other rather than upon differences in composition.

In 1849 (Am. Journ. of the Med. Sci.) Dr. Leidy announced a plan of the construction of the liver. He assumed that the follicul form of the liver in insects represented the plan of the primitive liver of the human embryo. The subsequent changes which lead up to the complex system of interlacing of tubules with their linings of biliary cells was the result of the blind end of the follicle undergoing subdivision by branching, each of the branches being lined with the cells and the mouths of the now open tubules, freely communicating with each other. This scheme was the most philosophical of any hypothesis previously proposed to account for the intricacy of the minute anatomy of the liver; it was accepted at once by the scientific world, and is itself an answer to the criticism sometimes made upon Dr. Leidy's labors, that they are purely descriptive. The evolution of the system of glands appended to the alimentary canal was distinctly set forth by Leidy in this paper. Since the relations of the liver as a blood-making and an excretory organ have been better defined, other hypotheses than that of Leidy have been proposed to elucidate its morphology.

But the latest expressions on the subject show an evidence of the reindorsement of the original statements.

In 1850 (Proc. Phil. Acad. Nat. Sci., 201) Dr. Leidy performed some experiments upon the transplantation of cancer. Taking several fragments of a cancerous tumor from a human subject he inserted them beneath the skin of living frogs. After an interval of five months had elapsed the frogs were killed and the localities in which the sections had been inserted were examined. In all but one instance they were found to be living and united to the host by vascular attachments. The characteristic cancer cells, however, had in great part disappeared. Dr. Leidy believed that similar experiments on warm-blooded animals might increase the number of viable cancerous elements. The transplantation of tissue from one animal to another was not novel, but the facts of these experiments proved that cancer might be inoculable, — a statement which was novel, and has been disputed since. The observation was in the line of most important research, and the recent experiments embracing the successful transfer of the human hypertrophied thyroid body from the neck to the abdomen of the same individual have been essayed with important practical results. They again demonstrate that Dr. Leidy's mind was not one limited merely to the line of description. At the time of these experiments Dr. Leidy was conducting a course of physiological instructions to medical students. No doubt remains that had he chosen physiology as a branch of research that he would have been signally successful.

In 1852, Dr. Leidy created from the species *Hippopotamus liberiensis*, Morton, a new genus, *Chœrodes*, which was founded upon the skeleton of a young individual. In the *Journal of the Philadelphia Academy* for 1850–54 this form was renamed *Chœropsis*, since *Chœrodes* was found to be previously assigned to a genus of insects. Abundant material of the adult has since been received in Paris and made the basis of an elaborate memoir by Alphonse Milne-Edwards, who has confirmed Leidy's diagnosis in every particular.

Opinions have differed widely as to the nature of dental caries. One set of observers claimed that it was due to vital or general conditions affecting the economy; another insisted that the disease was due to forces acting entirely from without. Since the bacteriological method of research has been introduced into medicine this difference of opinion no longer exists, for all agree that the statement last made is the correct one. Dr. Leidy in 1870 (Proc. Phil. Acad. Nat. Sci., 133) demonstrated in the subject of an old man that a single tooth remaining in the lower jaw was free from caries owing to the fact that it was imbedded in the bone. He thus demonstrated that caries was caused by extraneous conditions, for the disease was controlled by vital states of the individual, it was unreasonable to infer that they would not long before have attacked and destroyed the tooth that had so long remained in the jaw. This fertile suggestion anticipated the discovery of the bacillar origin of dental caries made by one of his pupils, Professor Miller of Berlin, several years afterward. The announcement of a new species of fossil horse and of a new species of Pæbrotherium, in 1847, brought to Dr. Leidy a reputation for acumen in the study of fragments of skeletons, and the study of the treasures of fossil remains in all sections of our country soon controlled his energies. While this work is strictly anatomical, its relations are in the main with geology; it is so vast in quantity that no attempt can be made here to discuss it, even if your speaker were competent to do so. This much can be said in dwelling upon his qualifications as an anatomist, so far as I know, there is but one instance of his having made an error in statement.[1] Attempts to protect from error often go with timidity, if they are not due to it. But in Leidy's case it was not over caution that saved him from error, but too correct primal impressions of the objects he studied. His powers of application were amazing, and the correctness of his conclusions was due to swiftly drawn deductions from the existing premises, and not to surmises or to feats of the imagination. In illustration of his ability may be mentioned his discovery of *Uineatherium*, — this genus he established upon a few fragments. Entire skeletons were afterward discovered, and two observers, independent of one another, endeavored to found distinct genera upon them. But all later writers have claimed that *Uineatherium* was indubitably founded on the fragments described by Leidy.

Exceptional ability in drawing just inferences from imperfect material signalized Leidy's labors in other directions. He delighted in this kind of work, and numbers of short communications were made by him on abnormalities. Among these may be mentioned the note on the dissection of a male hog, showing arrest of development in the organ of generation (Proc. Phil. Acad. Nat. Sci., 1870, 65); on "polydoctylism" in the horse (Proc. Phil. Acad. Nat. Sci., 1871, 112) and an account of a buffalo fish with congenital narrowing of the mouth (Proc. Phil. Acad. Nat. Sci., 1875, 125).

He was the first authority in the country on questions of disputed identifications. On one occasion a number of alleged fossil bones were sent him for examination, which proved to be inorganic concretions. On another a specimen which a zealous physician thought to be a new genus of parasite from the human intestine proved to be the fragment of imperfectly digested orange pulp. On yet another, a number of bones were sent to him by a physician who obtained them from a woman who claimed to have been pregnant. They were shown to be the bones of an embryo hog.

Dr. Leidy's communications on human anatomy have not been numerous, but they all exhibit the same closeness of observation, and cautious yet far-reaching conclusions.

In 1849, Dr. Leidy redescribed and placed on better foundation the thyreo epiglottideum muscle. In 18— he studied the development of the human temporal bone and described for the first time the attic or upper chamber of the middle ear. The term "attic" has come into general use with aurists. He also entered into a critical revision of the component parts of the petrosa, and corrected several errors into which no less authority than Huxley had fallen. His well-known work on human anatomy appeared in 1860. It was prepared especially for the use of his students at the university. The most noteworthy feature in this work was an attempt to anglicize anatomical nomenclature. In the second edition, which appeared in 1889, the same intent to reform nomenclature is apparent. This department of pedagogy, while of English origin, has had its most earnest exponents in America, and Dr. Leidy's labors in the field will hold always an honorable position. In his teaching, Dr. Leidy held to the existence of a vocal membrane in the larynx, rather than a vocal cord. His demonstration of the temporal muscle was original and clearly demonstrated the existence of two layers arising in an undifferentiated mass at the posterior part of the temporal fossa.

[1] He identified a fragment of the mandible of Bathygrathus as belonging to the maxilla. Owen invited his attention to it. Leidy said of this, "It was an egregious blunder, I cannot understand how I could have made it." A frank confession of a venial error.

From a man of Dr. Leidy's industry we may expect to hear of many plans entertained but subsequently abandoned, of many discoveries actually his own with which his name is not associated. At one time he contemplated writing a work on comparative anatomy, but was deterred from so doing when, upon inquiry of the publishers, he learned how small was the demand for writings of this kind. We cannot but regret that he did not entertain the subscription plan for reimbursement. For no one can doubt the fact that his admirers would have eagerly provided the means for publication had his wishes been more generally known. Respecting his unrecorded discoveries no one can speak with authority. On one subject he has himself spoken, namely, that the discovery of the tactile corpuscle on the nerves of the finger is his own. He occasionally referred to this as an instance of the dangers of procrastination in not placing upon record original observations the moment the facts became clearly defined in the mind of the investigator. He also frequently alluded to his having observed the amæboid movement in the white corpuscles. But he interpreted them to be pathological and hesitated in recording his discovery. This he used to say was one of the greatest mistakes of his life. But no discoveries of this kind were possible at the stage of microscope technique which Leidy commanded; were our knowledge of this property of the white blood corpuscle lost to us it would be exceedingly difficult to re-establish it without the use of the warm stage.

Such is a brief epitome of the labors of Joseph Leidy in the anatomy of vertebrates. It is a theme for a volume. But the man is greater than his works. All who knew Dr. Leidy are witnesses to the impression of strength in reserve he at all times made. It can be said of him as has been said of Haller by Francis Horner: "I never rise from an account of such a man without a sort of thrilling palpitation about me which I know not whether I should call admiration, ambition, or despair."

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Work and Energy.

IN many of the standard text-books and treatises on mechanics there is a lack of definiteness in the elementary treatment of the subjects of work and energy that often proves troublesome to the student. To illustrate this, let us place side by side the definitions of work and energy given in the "Syllabus of Elementary Dynamics" prepared by the Association for the Improvement of Geometrical Teaching.

(*a*) When the particle (or point of a body) to which a force is applied moves in the line in which the force acts, the force is said to do work, or to have work done against it, according as the motion is in the sense of the force or in the opposite sense.

(*b*) Energy is a general term for the capability of doing work, which from any cause a mass, or different masses in their relation to one another, may possess.

These definitions are in substantial agreement with those most often given, and are the only explicit statements usually found as to the meaning of work and energy.

A careful reading shows, however, that there is in definition (*b*) an implicit suggestion of something not definitely stated, and concerning which a definite statement is very much needed. According to the definition, energy is possessed by masses (i.e., by bodies); or, in other words, a body may do work. But what is meant by a body doing work? In most text-books the student will search in vain for a definite answer to this question.

Another question is suggested by the definition of work above quoted. It is clearly stated when work is done by a force and when work is done against a force. But in the latter case, what is it that does the work?

These two questions are sure to present themselves to the thoughtful student. If the definition of work were so stated as to furnish explicit answers to them, the acquirement of correct notions would be much facilitated.

A source of confusion slightly different from that above mentioned is found in certain books. Work is defined as if always done by forces; while energy is defined simply as capacity for doing work. The inference might naturally be drawn that energy is possessed by forces. But the student who draws this logical conclusion will be perplexed by finding that, in what follows, energy is always referred to as belonging to bodies instead of forces.

As an improved statement of the fundamental definitions of work and energy, the following may be suggested:

1. A force does work upon the body to which it is applied when the point of application moves (or has a component of motion) in the direction toward which the force acts.

2. A body does work against a force applied to it when the point of application moves (or has a component of motion) in the direction opposite to that toward which the force acts.

3. A body possesses energy when its condition is such that it can do work against applied forces.

Definitions (1) and (3) are not substantially different from definitions commonly given. Definition (2) is usually not given explicitly, though always implied in the development of the theory of energy.

It is quite possible that these definitions may admit of improvement. They must, of course, be accompanied by quantitative statements as to how work and energy are to be computed. But it is believed that the clear development of the subject is much facilitated if explicit definitions similar to these are given at the outset.

No attempt is here made to criticise all the various methods of treating the subject of work. Other forms of definition than the one above considered are found in various books. In most cases, however, they lead to the same difficulty above mentioned.

A treatment practically identical with that here suggested is adopted in McGregor's "Kinematics and Dynamics"—a book possessing many other admirable features—and possibly in other works. It certainly is not adopted by some of the best known English writers.

L. M. HOSKINS.

Madison, Wis., Nov. 9.

AMONG THE PUBLISHERS.

EVER since the announcement made last winter that the author of "Robert Elsmere" had a new novel under way, expectation has been eager to know when it would appear. Mrs. Ward, like George Eliot, has once more taught us that fiction, far from being merely a superficial representation of passing situations and emotions, may grapple with the greatest problems and teach men noble truths. It is with pleasure, therefore, that we publish the fact that Mrs. Ward's new book is to appear very soon from the press of Messrs. Macmillan & Co., New York, and that it is to be called "The History of David Grieve." It is understood that the book will trace the career of a disciple of the Elsmerian doctrines in his work among the poor of London.

—There lives an Indian people on the Carribbean coasts of Nicaragua and parts of Honduras, which is largely mixed with African and Indian elements, foreign to them, on the littoral tracts, but farther inside is of purer race. This people is known to the whites as Moskitos, or as they want to be called, *Misskitos*; their language was but imperfectly studied, probably because the tribes inspired their visitors with contempt on account of their subserviency to English interests. Only the missionaries of the Herrenhut denomination spent time enough for mastering entirely the intricacies of this tropical language, and from their writings,

as well as from those of Rev. M. Henderson, of Rev. W. Grunewald, and of three Prussian delegates sent to Nicaragua before 1845. Mr. Lucien Adam has made a through investigation of this tongue. His "Langue Moskito" has just been published by J. Maisonneuve, 25 Quai Voltaire, Paris, and forms the fourteenth volume of his "Bibliothèque linguistique Américaine" (124 pp., 8°). The texts include a number of stories from the New and Old Testament and some hymns, the ten commandments and two love songs, all with a French translation. The vocabulary fills thirty pages and the grammatic sketch contains the full paradigms of several verbs, which inflect by person-suffixes and possess a negative form. The phonetic side of the idiom may be characterized as rather vocalic than consonantic and the vowels *a*, *i*, *u*, largely exceed in frequency the other vowels.

— A novelty in calendars is the "Slide-Rule Perpetual Calendar," recently issued by the Jerome-Thomas Company of this city. As its name indicates, it is an application of the well-known slide-rule principle to a perpetual calendar, by means of a table of year-letters extending from the first year of the Christian era to the year 2800 (with means of infinite extension).

— The pictures of outdoor life in Canada presented in "Lady Dufferin's Journal" will interest many readers. Lady Dufferin gives a description of the various social and civic functions in which she took part with the Governor-General, and she also describes her salmon-fishing and camping trips. "Lady Dufferin's Journal" is published by D. Appleton & Co.

— Houghton, Mifflin, & Co. announce "Colonial Furniture of New England," a study of the domestic furniture in use in the seventeenth and eighteenth centuries, by Irving Whitall Lyon, M.D., member of the Connecticut Historical Society, illustrated with about one hundred large heliotypes; also the twelfth volume of the *Gentleman's Magazine Library*, comprising the articles on "English Topography," edited by G. L. Gomme.

— Another volume of Mr. Lowell's essays is said to be in the hands of his executor, Professor Norton, and will shortly be published. It will include Lowell's papers on Milton, Gray, and Landor; his sketch of Keats prefacing poems of Keats in the "British Poets"; his paper on Izaak Walton, printed as an introduction to the recent edition of "The Complete Angler," and an address before the Modern Language Association.

— Messrs. Longmans, Green & Co. will publish next month Mr. W. J. Henderson's new book, "Preludes and Studies; Musical Themes of the Day." The volume will contain a discussion of that fruitful theme, Wagner's "Ring des Nibelungen," together with other interesting Wagnerian essays. Perhaps the most valuable feature of the book for students and lovers of music in general will be the essay on "The Evolution of Piano Music," which includes a mass of facts not before accessible from any one source, and most of which are not to be found in any other work in English. The study of Schumann's symphonic writing will appeal to all readers who look below the surface of music.

— An account of "The Rise of the Pottery Industry," by Edwin A. Barber, is to appear in the December *Popular Science Monthly*. It will be illustrated with figures of early American ware, the apparatus used in making it, etc. This is the tenth article in the Monthly's illustrated series on American industries. Volcanoes in Connecticut are what very few persons would expect to find, but Prof. W. M. Davis has found a place near Meriden where they have been, and will describe his discoveries in an illustrated article. The fourth and last of Prof. Frederick Starr's papers on "Dress and Adornment" will also appear. It deals with "Religious Dress," including the dress of religious officers, of worshippers, of victims, of mourners, amulets and charms, and the religious meaning of mutilations. It will be illustrated. An invention that bids fair to work a revolution in printing, namely, type-casting machines, will be described by P. D. Ross. A cut of each of the two forms will be given. These machines are used by several of the largest newspapers in the United States, and have been ordered for a number of others. The principles involved in "The Training of Dogs" will be given by Dr. Wesley Mills. The article will contain pictures of a number of champion hunting-dogs.

— The History Company, San Francisco, Cal., have just issued another volume of H. H. Bancroft's series of "Chronicles of the Builders of the Commonwealth." Instead of following the publication of Vol. I. of this work with Vols. II., III., and IV., the publishers skip for the time being to Vol. V., the intervening volumes being nearly ready and to follow at short intervals. In the framework of Vol. V., the subject of which is "Routes and Transportation," there is much original matter. The material is drawn from innumerable original sources never before put into print. It covers the entire groundwork of inland and oceanic navigation, stage lines, telegraphic lines, and railway lines, the evolution of the express business, and everything connected with the subject in the fullest detail and in the most interesting style.

— One of the largest book deals ever consummated in America, it is reported, was closed Oct. 27 by cablegram, the University of Chicago being the purchaser and S. Simon of Berlin, the seller. The library contains 280,000 volumes and 120,000 dissertations in all languages. Among them there are 200 manuscripts from the eighth to the nineteenth century, 1,600 volumes of paleography, 15,000 journals, academies, and periodicals, 65,000 volumes of Greek and Roman archæology, 65,000 Greek and Roman classics, 2,400 volumes Greek and Latin authors of modern times, 2,000 Greek and Roman philology and grammar, 2,000 volumes general linguistics, 3,000 volumes modern linguistics, 2,500 volumes history, 1,000 illustrated works of art, 5,000 volumes physics, astronomy, and mathematics, and 5,000 volumes natural history.

— We have received from C. W. Bardeen of Syracuse a little pamphlet entitled "Thoughts from Earnest Women," arranged by the Women's Literary Club of Dunkirk. It consists of brief extracts, mostly in prose, from a large number of women writers of various times and countries, and is a collection of considerable merit. Most of the extracts relate to the conduct of life, some being moral, others prudential, and they indicate for the most part good sense both in the authors and in the compilers. The compilers are in favor of widening woman's sphere of work and of influence, and do not believe that she ought to confine herself exclusively to her family; and several of the authors quoted are advocates of woman suffrage. The interest of the collection, however, is by no means confined to women readers, but most of the extracts are as interesting and instructive to men as to women. The pamphlet is well worth the fifteen cents that it costs. Mr. Bardeen also sends us a work on "Elementary English," by John D. Wilson, prepared with reference to the Regents' examinations in the State of New York; but we cannot say that the work is well fitted for its purpose. The Regents issued in April last a bulletin in which they sketched a course of study in the elements of English, and this book has evidently been hastily gotten up to meet the Regents' requirements. The definitions are altogether too brief and too abstract, with very few illustrative examples; and the rules of punctuation are insufficient, and not illustrated by any examples at all. Moreover, there are some grammatical blunders in the book, as, for instance, in the first paragraph, where we read that "the word or words which makes the assertion is the predicate." When two subjects are connected by *or*, the verb ought to agree with the one that stands the nearest, and therefore the above sentence ought to have read thus: the word or words which *make* the assertion *are* the predicate. The book may be of some use to teachers as a synopsis of its subject, but it is of no value to students.

— Whittaker & Co., London, has just issued "Light" in the "Whittaker Library of Popular Science." This book is by Sir Henry Trueman Wood, Secretary of the London Society of Arts, who makes no pretence of being a specialist in the department of physics of which he writes, but he claims a thorough familiarity with the difficulties which beset the path of those humble students of science who can devote their leisure only, not their working life, to their favorite pursuit. This perhaps indicates, as well as

anything could, the mode of treatment of the subject; and, as to the scope of the book, it may be said that all the usual phenomena of light are described, and something of the theory given, though we do not find any reference to the recent investigations of Hertz and others showing experimentally the relation between light phenomena and those of electricity. Macmillan & Co. are the New York publishers.

— The Rev. Alfred J. Church, the well-known author of "Stories from Homer," etc., has written a novel of the time of Nero, which Macmillan & Co. will publish under the title of "The Burning of Rome." The book, which contains a number of illustrations, is just ready.

— "Principles and Practice of Plumbing," by S. Stevens Hellyer has just been issued by D. Van Nostrand Co., New York. It would seem that it might be difficult to find a person with sufficient knowledge of plumbing and having the habit of writing sufficiently developed who could produce a book on the subject. These two qualities are united in Mr. Hellyer, who is known for his earlier books, "The Plumber and Sanitary Houses," and "Lectures on the Science and Art of Sanitary Plumbing." The present volume is one of the series of "Technological Handbooks" edited by Sir H. Trueman Wood, Secretary of the London Society of Arts, to which Prof. William Crookes, for instance, contributed the initial number, on "Dyeing and Tissue-printing." The opening chapters are devoted to lead and its many uses in building operations, but the rest of the book contains much on what is known as sanitary engineering, at least in so far as this may be limited to the house.

— Houghton, Mifflin & Co. have published a small volume entitled "Land of the Lingering Snow," by Frank Bolles, being an account of outdoor walks in New England in spring time. It is, therefore, somewhat in the style of Thoreau's works, though Mr. Bolles is hardly equal to his prototype. His work is almost entirely descriptive, with hardly any of those moral reflections such as often light up the pages of Thoreau. Moreover, it is too full of petty detail, as the following specimen passage will show: "Leaving the railway, I wound my way back towards Stony Brook, passing through groves of small oaks, meadows full of treacherous pools covered with brittle ice, belts of whispering white-pines, apple orchards and wood-roads leading up hill and down, ending nowhere. Four miles of this wandering brought me to Kendal Green station in Weston, with a record of twenty crows, eighteen chickadees, sixteen tree-sparrows and three blue jays" (p. 40–41). For lovers of nature, however, the book will have an interest, and it is written in a simple and refined style.

— The November number of the *Annals of the American Academy of Political and Social Science* is interesting on account of the number of articles it contains which discuss new ideas

about American politics. Gamaliel Bradford is the author of the first article, which is entitled "Congress and the Cabinet," and which advocates permitting cabinet officers to appear in Congress to give advice and answer questions. "The Place of Party in the Politcal System," by Anson D. Morse of Amherst College, is a defense of the party system. E. P. Oberholtzer in his "Law making by Popular Vote," shows that there has been used at various times in American history a form of the Swiss Referendum. The other two main articles are "Recent Tendencies in the Reform of Land Tenure," by E. P. Cheyney, of the University of Pennsylvania, and "Some Neglected Points in the Theory of Socialism," by T. B. Veblen. The department of the *Annals* devoted to personal notes contains brief biographies of the following men, who have been appointed to positions in the schools of political science or political economy in the various colleges: J. R. Commons of Oberlin, W. M. Daniels of Wesleyan, Marietta Kies of Mills College, E. A. Ross of the University of Indiana, F. H. Hodder of Kansas State University, H. B. Gardner of Brown, S. B. Weeks of Trinity, N. C., C. G. Tiedeman of the College of the City of New York, C. F. A. Currier of the Massachusetts Institute of Technology, W. F. Willcox of Cornell, F. W. Moore, S. Sherwood, A. B. Woodford and L. K. Stein of the University of Pennsylvania, Max von Heckel of Wurzburg, Cort van den Linden of Amsterdam, and Achille Loria of Padua. There has been a change in the editorial force of the *Annals*. Professor F. H. Giddings, formerly one of the associate editors, has resigned on account of his many outside duties, and Dr. J. H. Robinson of the University of Pennsylvania has been appointed in his place. Dr. Robinson is lecturer on European history in the Wharton School of Finance and Economy, and is the author of a monograph on the "Original Features of the United States Constitution," and a work on the "German Bundesrath."